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ABSTRACT

A model for organizing an introductory in-service workshop for elementary school teachers in the basic fundamentals and contents of the metric system is presented. Data collected from various questionnaires and tests suggest that the program improved the teacher's performance in presenting the metric system and that this improvement had a positive effect on the children's level of knowledge of metrics. Contents include: Background Information, Development of Program Strategy Through Review of the Literature, Practicum Objectives, Implementation of the Program, Evaluation of the Metric Workshop Inservice Program, Institutionalization of the Program, Conclusions and Recommendations, tests and questionnaires used, and their results. (MP)

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DEVELOPMENT AND IMPLEMENTATION OF A METRIC INSERVICE PROGRAM FOR TEACHERS AT SAMUEL MORSE ELEMENTARY SCHOOL

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Submitted: July 1978

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DESCRIPTORS Elementary School Students; Elementary School Mathematics; Inservice Teacher Education; Instructional Materials; Metric System; Measurement; Elementary Education; Evaluation; Resource Materials; Program Development; Practicum.

ABSTRACT A model for organizing an introductory inservice workshop in the basic fundamentals and contents of the metric system was developed and field tested with 18 classroom teachers, grades one through six, at Samuel Morse Elementary School in Prince George's County, Maryland. The purpose of the practicum was to instruct the teaching staff in the basics of the metric system and to demonstrate relevant teaching strategies for instructing elementary students in metrics. A series of six workshops, held after school during the teachers' planning hours, was selected to accomplish the program objectives. Pre- and post-program assessment questionnaires were used to determine the need for the metric workshop and its effectiveness. Pre- and post-tests were designed to measure the teachers' knowledge of metrics before and after the workshop sessions, and to determine the effectiveness of the workshops. Post-tests were designed for students, appropriately adapted for grades one through six, to measure the effectiveness of the teachers' ability to teach metrics as a result of the workshops. In addition, teachers were observed three times in the classroom, with immediate follow-up conferences to give them feedback about their performance and assistance in ameliorating any problems. Data were collected from various questionnaires and tests. A comparative analysis of the teachers' pre- and post-test scores on these measures, coupled with other measures, suggests that the program did effect an improvement in the teachers' performance which had a positive effect on the children's level of knowledge of metrics.

The program will be continued, with minor modifications, at Samuel Morse Elementary School. Since there has been considerable interest in the program in the county, it will probably be adopted in other elementary schools in Prince George's County. It could be readily adopted in elementary schools nationwide.

DEVELOPMENT AND IMPLEMENTATION OF A METRIC INSERVICE PROGRAM FOR TEACHERS AT SAMUEL MORSE ELEMENTARY SCHOOL

by Thelma R. Butler[1]

Submitted in partial fulfillment of the
requirements of the National Ed.D. Program
for Educational Leaders, Nova University

Individual Practicum
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Submitted: July 1978

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Chapter I

BACKGROUND INFORMATION

The Prince George's County Public School System, which borders the nation's capital on the north and east, is one of the fastest growing counties in the State of Maryland. In 1976, it was ranked ninth in size among the largest school systems in the United States.[1] The population is varied and transient, mainly due to the many military installations in the area.

The practicum described in this paper took place at Samuel Morse Elementary School, located in a low-middle socioeconomic area of Prince George's County. It is almost a neighborhood school, ethnically balanced with about 43 percent minority enrollment. The school has approximately 450 pupils in grades one through six.

Introduction

Every American is facing the task of learning the metric system. This change from the English system of measurements to the metric system of measurements is inevitable as a result of the federal Metric Conversion Act of 1975, which was signed into law on December 22, 1975. Despite America's advanced

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[1]"A New Quality in Education," Education Quarterly, Winter 1976, p. 1.

technological society, conversion will not be as easy as some people have envisioned. The task of teaching the metric system to the American populace will largely fall on the educational community.[2] The elementary school is typically among the first organizations in the educational community to begin preparations for such a conversion. Therefore, the training of elementary school teachers should be planned as an initial, high-priority step in an effective metric conversion program.

As an elementary school assistant principal (at Samuel Morse Elementary School), the writer saw an opportunity to begin preparing her school population for the metric conversion. She recognized that teachers needed to be prepared or retrained to teach the new measurement system in such a way as to "supplant rather than supplement" our traditional system of measurement.[3] The National Bureau of Standards recommended a ten-year school metrication calendar for all school districts in 1971.[4] The first two years of this

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[2]Philip G. Jones, "Metric: Schools Will Be Teaching It and You'll Be Living It--Very, Very Soon," Education Digest 39 (November 1973): 23.

[3]Louis C. Fillinger, Learning and Teaching Metric Measurement: A Handbook for Teachers in the Elementary and Junior High School (Danville, Ill.: Interstate Printers and Publishers, 1974), p. 5.

[4]U.S. Department of Commerce, U.S. Metric Study: Interim Report--Education, National Bureau of Standards, Special Publications 345-6 (Washington, D.C.: U.S. Government Printing Office, 1971), p. 46.

calendar were to be devoted to planning, training teachers, and curriculum research. In view of this national suggestion, the writer discussed with the principal the need for staff instruction in the basics of metric content. The principal agreed that this need probably existed at Samuel Morse Elementary School and approved initiation of an appropriate program.

Statement of the Problem

Recently the Maryland State Board of Education mandated that a plan and procedure for complete metrication of all phases of public school operation in Maryland be developed by 1980. Local schools were charged with taking the initiative in designing and implementing programs to meet the needs of their teachers and students. The changeover to the metric system of measurement had already begun in other school districts throughout the United States. The Prince George's County Public School System realized the importance of training teachers and exposing students to metrics. Many teachers and educational organizations have supported the adoption of the metric system for some time, because its decimal basis conforms to our numeration system and it is a simple, logically planned system. However, the major concern facing the county school system was that the vast majority of teachers had insufficient knowledge to teach metrics, particularly at the elementary level. At Samuel Morse Elementary School, the curriculum did not

include metrication. To best serve the school populace, a significant number of our teachers needed training in metrics before metrication could be introduced into the school's curriculum.

The writer discussed the problems of introducing metrics into the curriculum with the school's 18 classroom teachers and asked them to answer an assessment questionnaire to obtain information about their knowledge and experience in teaching metrics (see Appendix A, p. 32). In response to the assessment questionnaire, 89 percent of the teachers indicated that they had had no college level training in metrics; 89 percent also indicated that they did not feel qualified to teach metrics. For additional information about responses to the questionnaire, see Table 1 on page 5.

Additional evidence of the need for teacher training workshops in metrics at Samuel Morse came from the results of a pretest given to the teachers to determine their knowledge of metrics (see Appendix B, pp. 33-34). On the basis of overall test scores, 89 percent of the teachers fell below the seventieth percentile (see Table 2 on page 6).

The need for metric training at Samuel Morse was further indicated by extensive classroom observations and informal conversations with teachers and students about products such as milk, gasoline, boxed foods, and road signs which are already being labeled in metrics. Not only must metric education proceed

because of federal legislation--and actions taken by other countries throughout the world--but because U.S. industry has already made strong moves toward the use of the metric system.

Table 1

Baseline Assessment of Teachers' Skills in Metrics

N=18*

Skills/Experience	Number	Percent
1. No previous college course	16	89
2. Did not feel qualified to teach metrics	16	89
3. Did not know about the state mandate for teaching metrics	13	72
4. Felt:		
a. very well prepared to teach metrics	2	11
b. fairly well prepared	4	22
c. inadequately prepared	12	67
5. Felt students were:		
a. very well prepared in metrics	2	11
b. fairly well prepared	4	22
c. inadequately prepared	12	67
6. Currently teaching:		
a. a lot of metrics	2	11
b. very little metrics	4	22
c. no metrics	12	67
7. Felt there was a need for a metric workshop	18	100

*Information about the teachers' experiential background, degrees attained, professional status, and instructional grade level are given in Appendix C, p. 35.

Table 2

Teachers' Metric Pretest Scores

N=18

Pretest Scores in Percentiles	Percent of Teachers Achieving Score	
91 - 100	0	
81 - 90	0	
71 - 80	11	
61 - 70	39	89
Below	50	

On the basis of the data collected, there was clearly a need for the proposed inservice training program in metrics. Further, all 18 teachers had expressed a desire for such a program (see Table 1 on the preceding page). The writer therefore developed a proposal to plan, coordinate, and implement a model for organizing introductory inservice metric workshops at Samuel Morse Elementary School that would improve the teachers' instructional skills and knowledge in metrics, and also help make classroom activities a more relevant experience for students. The school's principal gave approval to this plan.

Chapter II

DEVELOPMENT OF PROGRAM STRATEGY THROUGH REVIEW OF THE LITERATURE

The characteristics and components of the introductory model workshop in metrics that was developed were suggested by a review of the literature. America's gradual conversion to the metric system became inevitable with the passage of the U.S. Metric Conversion Act of 1975. The United States is no longer concerned with the question of "when" conversion will occur--it is already occurring. It is now a question of "where" and "how." The brunt of the task of converting to the metric system will fall on the educational community, for schools are largely "where" conversion will be learned.

Teacher training is certainly necessary for educators to enable them to teach metrics properly. The 1971 National Bureau of Standards study recommended a coordinated national program to change deliberately and carefully to the metric system. Among these recommendations was one which has had considerable impact on education: "That early priority be given to educating every American school child and the public at large to think in metric terms."[1] The appropriate education of students is the most important factor for a successful conversion.

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[1]Fred J. Helgren, "Schools Are Going Metric," The Arithmetic Teacher 20 (April 1973): 311.

Congress' metric message to the educational community, as reflected in the literature, was to start to convert local educational programs now. A ten-year school metrication calendar issued to all school districts specified that the first two years should be devoted to "planning, training teachers, and curriculum research."[2] Teachers would have to be prepared or retrained to teach the new measurement system.

Most educators agreed that eight to fifteen hours of inservice training would suffice to prepare teachers to teach metric.[3] A basic introduction to metrics is essential, for teachers must know and understand metrics themselves before they can teach it to children. They do not, however, have to learn everything about the system in order to begin teaching the fundamentals. "Inservice training for going metric," King and Whitman emphasized, "should be condensed into a short period of time just before the teachers begin to teach the metric system. Because teachers generally teach as they are taught, the training should be similar to that which they will use with their students."[4]

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[2]Jones, "Metric: Schools Will Be Teaching it and You'll Be Living It," p. 24.

[3]U.S. Department of Commerce, U.S. Metric Study: Interim Report--Education, p. 49.

[4]Irv King and Nancy Whitman, "Going Metric in Hawaii," The Arithmetic Teacher 20 (April 1973): 260.

Elementary school teachers will require the most intensive training.[5] Early elementary teachers must be especially familiar with the metric system, for it is important not to confuse beginners with the two systems of measurement. Inservice training activities can be carried out in a number of ways. Programs for inservice training can be completed in preplanning days, during teacher work days, in weekend workshops, or through television instruction. Most instruction occurs in after-school sessions. In setting up teacher workshops in metric education, it is essential that "emphasis should lie in the strategies and tactics for teaching measurement in early and later years, and in achieving at least the beginning of an easy familiarity with the metric units."[6]

The strategies for teaching metrics are learned as the teachers experience metrics in the workshop situation. The essential component of teacher training workshops is that the material stimulate the participants and give them something to take away with them to teach to others. Only by experiencing the measurement system themselves can they attempt to instruct students. Viets explains that "Teachers must assume the obligation to prepare themselves, their pupils, and subsequently, the public to meet our country's commitment to go metric."[7]

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[5]U.S. Department of Commerce, U.S. Metric Study: Interim Report--Education, p. 49.

[6]Ibid., p. 53.

[7]Lottie Viets, "Experiences for Metric Missionaries," The Arithmetic Teacher 20 (April 1973): 315.

Too often the study of measurement has consisted solely of written work. Lack of attention to activities encouraging thinking and estimating in a measurement system has made study dull for pupils. Suydam suggests that "hands on experiences" should focus on measurement, letting the students practice in estimating and then measuring.[8]

The metric system can seem very difficult if instructions deal with the full range of units. The general public only needs to know the following metric units: meter, kilometer, centimeter, milliliter, liter, gram, kilogram, and ton.[9] These units will suffice for 90 percent of the public's needs.

Finally, the Gilberts, in their book Thinking Metrics, suggested that:

> . . . you needn't wait for your country to complete its conversion to the metric system before you put this system to practical use. You will find that a few hours of training or reading will be useful to you right now--particularly if you teach science or mathematics. But even if you don't do any of these things, you will need to know what metric measurement is about so you can understand the articles you'll be seeing more and more frequently in newspapers and magazines as we go completely metric.[10]

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[8]Marilyn N. Suydam, "Metric Curriculum: Scope, Sequence, and Guidelines," in A Metric Handbook for Teachers, J. L. Higgins, ed. (Reston, Virginia: National Council of Teachers of Mathematics, 1974), p. 81.

[9]John L. Feirer, "Now Is a Good Time to Get Started in Metrics," Industrial Education 64 (September 1975): 32.

[10]Thomas F. and Marilyn B. Gilbert, Thinking Metric (New York: John Wiley and Sons, Inc., 1973), p. 5.

Drake also points out the importance of fundamentals, stating that "You don't need a warehouse of materials to begin training teachers in metrics, start with . . . basic equipment. This is what they are to learn, the basic fundamentals in metric."[11]

In summary, the writer found the review of the literature extremely helpful in planning, organizing, and implementing the inservice workshops. Specific attributes of an effective metric workshop inservice program were obtained from the literature, which also suggested that the program be simplified, comprehensive, and continuous.

The practicum objectives, evaluative treatment, and program implementation (which are discussed in subsequent sections of this report) were largely based on the review of the literature.

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[11]Paula Drake, "Hello Metrics," Teacher 92 (October 1974): 46.

Chapter III

PRACTICUM OBJECTIVES

The objectives of the practicum, and evaluative treatments, are described below.

Process Objective 1

It was assumed that by October 1977 90 percent of the teachers would have participated in six inservice workshop sessions on metric education.

Evaluative Treatment

Logs of teacher participation in the metric workshops were to be kept by the coordinator (the writer) as part of the normal operating procedures of the school.

Process Objective 2

It was assumed that by April 1978 90 percent of the teachers would have been observed three times in the classroom by the coordinator and that they would have had three individual follow-up conferences with the coordinator to discuss the performances observed, the progress they had made, and their needs for materials and/or instructional assistance from the coordinator.

Evaluative Treatment

The classroom observations were to be logged on a classroom observation form by the coordinator (see Appendix D, p. 36).

and the results of each of the teachers' three follow-up conferences were to be recorded on a follow-up conference form (see Appendix E, p. 37).

Product Objective 1

By April 1978, 90 percent of the teachers were to have been observed three times by the coordinator and all 90 percent were expected to have achieved a performance of "very good" on 90 percent of the skills to which they had been exposed in the workshops, as listed on the coordinator's classroom observation checklist (see Appendix D, p. 36).

Evaluative Treatment

The coordinator was to record her classroom observations on the observation checklist at the time of each observation.

Product Objective 2

By April 1978, 90 percent of the teachers were to have taken a post-test in metric knowledge and all 90 percent were expected to achieve a score of 85 percent or higher on the metric test (a minimum of 27 correct responses out of 31 answers).

Evaluative Treatment

The coordinator was to administer a post-test to the teachers in metrics (see Appendix F, pp. 38-39) and the overall scores were to be tabulated and compared with the pretest scores (see Chapter I, p. 6).

Product Objective 3

Beginning in school year 1977-78, and continuing thereafter, instruction for children was to be carried out as their respective teachers received proper training in the metric system. By May 1978, it was expected that 90 percent of the children would be able to pass a post-test with scores of 80 percent or better. (Since the children had not been receiving instruction in metrics prior to the program, a pretest was not administered.)

Evaluative Treatment

Teachers on each grade level were to design a metrics test based on the specific classroom objectives for the youngsters. The tests were to be administered in May 1978, and the scores were to be tabulated (see Appendix G, pp. 40-45 for the tests designed for each grade level, one through six).

Chapter IV

IMPLEMENTATION OF THE PROGRAM

Preparation for the metric inservice workshops at Samuel Morse Elementary School began in February 1977, with the principal and the writer discussing the need for teacher training in metrics, as described in Chapter I. Following the meeting with the principal, the writer began reviewing relevant literature and developing plans and workshop guidelines.

In early May 1977, the writer met with the 18 classroom teacher participants, outlined the program plans, and administered both a pre-program assessment questionnaire (see Appendix A, p. 32) and a metric quiz pretest (see Appendix B, pp. 33-34) to them. By August 1977, the metric program plans had been finalized, with the help of the math supervisor and the principal, and the materials selected for instruction had been obtained.

Six inservice workshop sessions in metrics were held during the period from September 20 through October 6, 1977. Each session lasted approximately one and one-half hours; the sessions were held twice a week. All 18 of the teachers involved were present for all six sessions and participated in all of the workshop activities. (See Appendix H, pp. 46-47 for a description of the workshop schedule and agenda.)

Having completed all but one of the workshop sessions, the teachers began classroom instruction in metrics on October 3, 1977. Each of the teachers was observed in the classroom three times by the writer. These observations took place in October of 1977, January and February of 1978, and March of 1978. The observations lasted a minimum of thirty minutes and were focused on the teachers' ability to perform the items on the classroom observation checklist (see Appendix D, p. 36). The observations were unscheduled, to ensure that teachers were teaching in their usual manner, rather than having specially prepared for the observation. The classroom observation checklist was completed by the writer both during and immediately after the formal observation. As stated above, all 18 teachers were observed three times.

All 18 of the participants had three follow-up conferences with the writer (see Appendix E, p. 37 , for the follow-up conference form.) These follow-up conferences commenced on October 4, 1977, and continued through March 21, 1978. In each instance, the conference was held on the day of the observation and generally lasted approximately twenty minutes. For a listing of the dates of each classroom observation for each teacher and for each follow-up conference, see Appendix I, p. 48).

The format for the conferences was as follows:

1. Establishing rapport.
2. Discussing the performance areas observed.

3. Commending the teacher, when applicable, for specific strategies performed.
4. Recommending future action plans, in terms of amended strategies for teaching and additional materials.
5. Pointing out weaknesses in performance, when applicable.
6. Developing action plans for improvement of specific performance areas.

On April 18, 1978, the writer met with the staff to review the year's efforts, discuss the effectiveness of the inservice workshops, and obtain the teachers' suggestions for overall improvement of the program. At this time, three evaluative questionnaires were administered:

1. a metric system post-test to determine the teachers' post-program knowledge of metrics in comparison with their pre-program knowledge (see Appendix F, pp. 38-39 for the test),
2. a post-program assessment questionnaire to compare the teachers' overall program-related assessment to their pre-program assessment (see Appendix J, p. 49), and
3. a questionnaire to obtain the teachers' evaluations of the metric workshop sessions (see Appendix K, pp. 50-51).

All 18 teachers responded to all three measures.

In May of 1978, the students at each grade level were given a metric quiz (see Appendix G, pp. 40-45). These results were tabulated and recorded.

Throughout the practicum, the writer met periodically with the principal to keep him informed about the development and progress of the program. The principal approved each stage of development.

Resources for Achieving the Program Objectives

The Prince George's County Public School System was charged by the State of Maryland with the responsibility of providing programs to educate its school population in the metric system. The principal of Samuel Morse Elementary School readily gave approval to the writer's plans for meeting the State mandate. The Prince George's County Board of Education therefore appropriated $150 for basic and equipment. This limited amount, coupled with the teachers' inventiveness, proved adequate but somewhat restrictive. Additional funding would have been helpful.

The coordinator (the writer) reorganized her daily schedule to meet the time requirements of the program, without difficulty. There was somewhat more inconvenience to the teachers. Although the workshop sessions, observational follow-up conferences, and post-program evaluation session were held during the teachers' normal after-school hours, these activities took up time during which they would normally have graded papers and made up lesson plans. Despite this additional burden on their workload, the teachers enthusiastically participated in all phases of the program.

Chapter V

EVALUATION OF THE METRIC WORKSHOP INSERVICE PROGRAM

A number of measures were used to evaluate the teachers' progress in the program, the students' progress in the program, and the effectiveness of the workshops. Data collected from the teachers and the students served as the bases for the evaluation, coupled with systematic classroom observations.

Basic Data Collected

The data obtained with regard to the major objectives of the practicum are presented as follows: each objective is stated, with a summary of the results of the program in relation to that objective following immediately thereafter.

> Process Objective 1: It was assumed that by October 1977 90 percent of the teachers would have participated in the six inservice workshop sessions on metric education.

Results Achieved: By October 6, 1977, 100 percent of the teachers had participated in six workshop sessions in metrics This was documented by a record of each teacher's participation, kept by the coordinator as part of the school's normal operating procedures.

> Process Objective 2: It was assumed that by April 1978 90 percent of the teachers would have been observed three times in the classroom by the coordinator and that they would have had three individual follow-up conferences with the coordinator to discuss the performances observed, the progress they had made, and their needs for materials and/or instructional assistance from the coordinator.

Results Achieved: By April 1978, 100 percent of the teachers had been observed three times in the classroom by the coordinator and they had had three individual follow-up conferences with the coordinator to discuss the performances observed, the progress they had made, and their needs for materials and/or instructional assistance from the coordinator. (See Appendix I, p.48, for documentation of the dates of the observations and follow-up conferences.) Note that 100 percent of the teachers, rather than the predicted 90 percent, were observed three times in the classroom and had follow-up conferences on the same day as the observation.

> Product Objective 1: By April 1978, 90 percent of the teachers were to have been observed three times by the coordinator and all 90 percent were expected to have achieved a performance of "very good" or better on 90 percent of the skills to which they had been exposed in the workshops, as listed on the coordinator's classroom observation checklist (see Appendix D, p. 36 for the checklist).

Results Achieved: By April 1978, 100 percent of the teachers had been observed three times by the coordinator, as described above. As is shown in Table 3 on page 21, the goal that 90 percent of the teachers would attain classroom performance ratings of "very good" or above on 90 percent of the skills to which they had been exposed in the workshops was very nearly, but not fully, met. At the time of the third observations in March, 90 percent of the teachers did attain

ratings of "very good" or above for six of the skills (60 percent of the skills). On the remaining four skills , 89 percent of the teachers were rated as "very good" or above--in each case just 1 percent below the goal of 90 percent. Thus, the goal was almost met for all ten of the skill areas.

Table 3

Coordinator's Evaluation of Teachers' Classroom Performance

N=18

Skills Observed: Observation 3 (March 1978)	Percent of Teachers Attaining Rating		
	Excellent	Very Good	Total*
1. Lesson preparation	16	78	94
2. Aims and procedures clearly defined	33	67	100
3. Appropriate variety of activities	33	56	89
4. Use of motivational factors	44	56	100
5. Knowledge of subject matter	22	67	89
6. Sufficient teaching aids	33	56	89
7. Systematic and orderly progression	39	50	89
8. Full class participation	56	44	100
9. Method of homework (or class) assignment	78	22	100
10. Evidence of metric displays	44	56	100

*Total percentage of teachers attaining ratings of "very good" and above.

Full documentation of the teachers' ratings for all three observations is given in Appendix L, pp. 52-53.

Product Objective 2: By April 1978, 90 percent of the teachers were to have taken a post-test in metric knowledge and all 90 percent were expected to achieve a score of 85 percent or higher on the metric test (a minimum of 27 correct responses out of 31 answers).

Results Achieved: By April 1978, 100 percent of the teachers had taken the post-test in metrics and all 100 percent achieved scores of 87 percent or higher (see Table 4). This represents an average rise of 37 percent on the post-test scores, as compared with the pretest scores. (See Table 2 on page 6 for the pretest scores.) On the pretest, 89 percent of the teachers fell below the seventieth percentile. A more detailed comparison of the pre- and post-test scores is given in Appendix M, p. 54.

Table 4

Teachers' Metric Post-Test Scores

N=18

Post-test Scores in Percentiles	Percent of Teachers Achieving Score	
91 - 100	78	100
81 - 90*	22	
71 - 80	0	
61 - 70	0	
Below		

*None of the teachers scored below 87 percent. See Appendix M, p. 54.

Product Objective 3: Beginning in school year 1977-78, and continuing thereafter, instruction for children was to be carried out as their respective teachers received proper training in the metric system. By May 1978, it was expected that 90 percent of the children would be able to pass a post-test with scores of 80 percent or better. (Since the children had not been receiving instruction in metrics prior to the program, a pretest was not administered.)

Results Achieved: Beginning on October 3, 1977, instruction for children throughout the school in grade levels one through six was carried out. The instruction continued until the end of the school year. (The program of instruction will be continued during school year 1978-79, with minor modifications. See Chapter VI, p. 29.) When instruction began on October 3, all of the teachers had attended five of the six workshop training sessions. The sixth session was held on October 6. The teachers had therefore received training before they began teaching metrics.

The teachers on each grade level designed a metrics test based on the specific classroom objectives for the youngsters. The tests were administered in May 1978 (see Appendix G, pp. 40-45) for the tests designed for each grade level, one through six). As shown in Table 5 on page 24, 97 percent of the students achieved year-end post-test scores of 81 percent or higher. This is a considerably higher level of achievement than was predicted. A more detailed description of the children's post-test scores, by grade level, is given in Appendix N, p. 55.

Table 5

Children's Metric Post-Test Scores

N=444

Post-test Scores in Percentiles	Percent of Students Achieving Score	
91 - 100	63	97
81 - 90	34	
71 - 80	2	
61 - 70	0	
Below	0	

Additional Data Collected

In addition to the basic data collected to measure the effectiveness of the program in relation to the major objectives, other data about the effectiveness of the program were obtained. These measures are discussed below.

Teachers' Evaluations of the Metric Workshops

In April 1978, the teachers answered a questionnaire evaluating the workshop sessions held the previous September. The questionnaire and the teachers' responses to it are shown in Appendix K, pp. 50-51. Sixty-seven percent of the teachers rated the sessions as "excellent" or "very good." Thirty-three percent rated them as "average." All 18 teachers felt similar workshop sessions should be held each year, with 17 teachers stating that more workshop sessions should be held earlier in the year. All of the teachers felt that a

greater variety of materials should be offered. About a third of the teachers suggested that more persons take part in the planning in the future and that more explicit information on metric background and SI be given.

All 18 teachers said they felt the workshops had helped them understand the metric system better, and that they had liked the orderly functioning of the program, the video tapes, the firsthand information, and sharing ideas with others. Sixteen of the teachers said the workshops had provided them with helpful information.

Comparison of the Teachers' Responses to the Pre- and Post-Program Assessment Questionnaires

Additional evidence of the effectiveness of the workshops is derived from a comparison of the teachers' responses to the pre- and post-program assessment questionnaires (see Table 6 on page 26). In May of 1977, when the pre-program questionnaire was administered, only 11 percent (two) of the teachers felt qualified to teach metrics. In April of 1978, when the post-program questionnaire was given, 89 percent of the teachers felt qualified. Further, the percentage of teachers who said they felt very well prepared to teach metrics rose from 11 percent to 89 percent. Prior to the program, 67 percent of the teachers felt inadequately prepared to teach metrics; after the program, none of the teachers said they felt inadequately prepared.

Prior to the program, only 11 percent of the teachers were teaching "a lot of metrics" in the classroom; post-program, 83 percent were teaching a lot of metrics. Similarly, before

Table 6

Comparison of Teachers' Pre- and Post-Program Assessment of Their Skills in Metrics

N=18

Skills/Experience	Pre-Program*	Post-Program*	Difference
1. No previous college course	89	89	---
2. Felt qualified to teach metrics	11	89	+78
3. Knew about the state mandate for teaching metrics	28	100	+72
4. Felt:			
a. very well prepared to teach metrics	11	89	+78
b. fairly well prepared	22	11	-11
c. inadequately prepared	67	0	-67
5. Felt students were:			
a. very well prepared in metrics	11	89	+78
b. fairly well prepared	22	11	-11
c. inadequately prepared	67	0	-67
6. Currently teaching:			
a. a lot of metrics	11	83	+72
b. very little metrics	22	17	- 5
c. no metrics	67	0	-67
7. Felt there was a need for a metric workshop	100	100	---

*Percentage of teachers responding to item.

the program, only 11 percent of the teachers felt that the students were very well prepared in metrics; after the program, 89 percent felt the students were well prepared. Prior to the program, 67 percent of the teachers felt the children were inadequately prepared in metrics; after the program, none of the teachers felt that the children were unprepared.

On both the pre- and post-program questionnaires, all of the teachers indicated that there was a need for a metric workshop. This gives further support to the practicum concept.

Use of Classroom Observations and Follow-Up Conferences As an Inservice Training Technique

The use of three classroom observations and three follow-up conferences during the school year, originally designed as an evaluation measure for the effectiveness of the workshops, also proved effective as a continuation of the inservice metric training program for teachers. Appendix L, pp. 52-53 , shows the teachers' ratings on 10 skill levels at three different points in time. There is a steady and consistent upward rise in proficiency for all 10 skill areas. Although a portion of this increase in skills is undoubtedly due to the teachers' increasing familiarity with metrics, it is felt that the process of observing teachers and giving them feedback about their performance, along with suggestions for improvement and provision of additional materials and instructional guidance from the coordinator, contributed substantially to their increase in skills.

On the basis of the evaluation measures shown above, and the clear enthusiasm of the teachers and students for the program, the Board of Education of Prince George's County approved continuation of the program at Samuel B. Morse Elementary School for the school year 1978-79. Because of the State of Maryland's mandate that metric education be adopted by 1980, a program in metrics was inevitable. What is important in terms of this practicum program is that its documented results, and the teachers' evaluations of it, coupled with the students' spontaneous expressions of interest, have resulted in continuation of the program as originally designed, with only minor modifications.

Chapter VI

INSTITUTIONALIZATION OF THE PROGRAM

The practicum metric education program has become a part of Samuel B. Morse's ongoing curriculum. Training sessions for teachers are to be held every year for all new staff members, as well as for any other staff member who wishes a refresher course. As an ongoing dimension of the program, training sessions are to be held every two years to sharpen and extend the level of staff performance in the area of metrics.

One of the Prince George's County Public School System's supervisors of education was aware of the program and observed it in action. As a result, he asked the writer to describe the program at a June 1978 meeting of vice principals. The participants at the meeting asked that copies of this practicum report be distributed to them when NOVA has approved it, along with samples of the materials used in the classroom.

It is felt that this model can easily be implemented in any school system in the United States, because it has been proved under real conditions by practicing elementary teachers.

Chapter VII

CONCLUSIONS AND RECOMMENDATIONS

The metric workshops at Samuel Morse Elementary School proved to be a significant and worthwhile endeavor. The program followed the County school system guidelines. There were no major constraints inherent in the program that prevented the writer from carrying out her usual daily routine of administrative tasks.

The metric inservice education program will be carried out in the future at Samuel Morse Elementary School, and probably other elementary schools in the county, with only the following modifications: 1) that teachers take part in the planning, 2) that a greater variety of materials should be available both for the workshop sessions and in the classroom, 3) that more financial assistance be available (which would enable the greater variety of materials the teachers feel would be desirable), and 4) that the workshops be concentrated during the four pre-school professional days, which would both ensure earlier training and prevent an impingement on their after-school planning time.

Within the guidelines established by other school jurisdictions, this program should lend itself readily to adaptation by elementary school administrators throughout the nation.

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Appendix A

PRE-PROGRAM ASSESSMENT QUESTIONNAIRE FOR TEACHERS

Please answer the following questions:

1. Have you had a college course in metrics?

   Yes _____ No _____

2. Do you feel qualified to teach the metric system?

   Yes _____ No _____

3. Do you know the state mandate for teaching the metric system?

   Yes _____ No _____

4. How prepared are you in the basic fundamentals of metrics?

   a. very well ___ b. fairly well ___ c. inadequately ___

5. How prepared are the students in your class in metrics?

   a. very well ___ b. fairly well ___ c. inadequately ___

6. Are you teaching metrics in your class?

   a. very much ___ b. very little ___ c. not any ___

7. Do you feel there is a need for metric workshop/inservice?

   Yes _____ No _____

Appendix B

METRIC SYSTEM PRETEST FOR TEACHERS

I. Here is a list of prefixes for metric units. Write the correct numerical value of each.

a. Centi _____
b. Deci _____
c. Deka _____
d. Hecto _____
e. Kilo _____
f. Milli _____

II. In what metric units would you measure:

a. the distance to New York? _____
b. the diameter of a drinking straw? _____
c. the mass of a hamburger? _____
d. the capacity of a large pitcher? _____
e. the liquid in an eye dropper? _____

III. Change the following units of measure to the indicated unit:

a. 9 meters = _____ centimeters
b. 20 meters = _____ centimeters
c. 6 kilometers = _____ meters
d. 15 kilometers = _____ meters
e. 12 kilograms = _____ grams
f. 137 kilograms = _____ grams

IV. The base unit of time in the metric system is the second(s). Try to match each of the following units with its definition.

1. centisecond	_____	a. 100 seconds
2. decisecond	_____	b. 10 seconds
3. dekasecond	_____	c. 1/10 seconds
4. hectosecond	_____	d. 1000 seconds
5. kilosecond	_____	e. 1/1000 seconds
6. millisecond	_____	f. 1/100 seconds

V. Choose the answer you think is correct.

1. The base temperature scale used in the metric system (SI) from which the derived units originate is the:

a. _____ Celsius scale
b. _____ Kelvin scale
c. _____ Fahrenheit scale
d. _____ Centigrade scale

2. Normal body temperature is about:

_____ $25^{o}C$
_____ $37^{o}C$
_____ $45^{o}C$
_____ $52^{o}C$

Appendix C

TEACHERS' BACKGROUNDS AND QUALIFICATIONS

Teaching Experience

0 - 5 years	5
6 - 10 years	8
11 - 15 years	4
16 - 20 years	1
Total	18

Degrees

Bachelors'	14
Masters'	4
Beyond	0
Total	18

Professional Status

Tenured	17
Nontenured	1
Total	18

Instructional Grade Level

Grade 1	3
Grade 2	4
Grade 3	4
Grade 4	3
Grade 5	2
Grade 6	2
Total	18

Appendix D

COORDINATOR'S CLASSROOM OBSERVATION CHECKLIST

Teacher's Name _____ Date of Observation _____

SKILLS TO BE OBSERVED	LEVEL OF PERFORMANCE			
	Excellent	Very Good	Acceptable	Needs Improvement
1. Lesson preparation				
2. Aims and procedures clearly defined				
3. Appropriate variety of activities				
4. Use of motivational factors				
5. Knowledge of subject matter				
6. Sufficient teaching aids				
7. Systematic and orderly progression				
8. Full class participation				
9. Method of homework (or class) assignment				
10. Evidence of metric displays				

Appendix E

FOLLOW-UP CONFERENCE FORM

Teacher's Name_____ Date _____

Grade Teaching _____

Commendations:

Recommendations/ Assistance:

Conference held: ____Yes ____No ____Not observed

Action plans:

Teacher _____ Coordinator _____
Signature Signature

Appendix F

METRIC SYSTEM POST-TEST FOR TEACHERS

I. Here is a list of prefixes for metric units. Write the correct numerical value of each.

a. Hecto _____
b. Milli _____
c. Centi _____
d. Kilo _____
e. Deci _____
f. Deka _____

II. In what metric units would you mesure:

a. the liquid in a test tube: _____
b. the capacity of a large jar? _____
c. the distance to New Hampshire? _____
d. the diameter of a nail _____
e. the mass of a hamburger _____

III. Change the following units of measure to the indicated unit:

a. 12 kilograms = _____ grams
b. 20 meters = _____ centimeters
c. 15 kilometers = _____ meters
d. 9 meters = _____ centimeters
e. 137 kilograms = _____ grams
f. 9 kilometers = _____ meters

IV. The base unit of time in the metric system is the second(s).

Try to match each of the following units with its definition.

1.	dekasecond _____	a.	1000 seconds
2.	decisecond _____	b.	100 seconds
3.	kilosecond _____	c.	10 seconds
4.	centisecond _____	d.	1/1000 seconds
5.	hectosecond _____	e.	1/100 seconds
6.	millisecond _____	f.	1/10 seconds

V. Choose the answer you think is correct.

1. The base temperature scale used in the metric system from which the derived units originate is the:

a. _____ Celsius scale
b. _____ Kelvin scale
c. Centigrade scale _____
d. Fahrenheit scale _____

2. Normal body temperature is about:

_____ $45^{o}C$
_____ $37^{o}C$
_____ $52^{o}C$
_____ $25^{o}C$

Appendix G

METRIC TEST FOR STUDENTS - Grade Level 1

Directions: Fill in the blanks with the correct word. Use the words from the chalkboard.

1. The _____ is the base unit of length in metric system.

2. To measure milk in a container, you use the _____ .

3. Centimeters are smaller than meters. Circle things you measure with centimers:

   YOUR HEAD AN ELEPHANT YOUR HAND

4. Circle things you measure with the meter:

   DESK CHALKBOARD WATER DOOR

5. We use a gram to measure weight. Name two things we measure using the gram.

   _____ _____

6. Circle the one we use to measure temperature.

   A YARD STICK CELSIUS SCALE

METRIC TEST FOR STUDENTS - Grade Level 2

Directions: Fill in the blanks with the correct word or words. Use the words from the board.

1. Meters and centimeters are used to measure _____ in the metric system.

2. The _____ system is a decimal system of measurement.

3. You can use a _____ to find out how much a container of milk holds.

4. "Centi-" means _____.

5. To measure the temperature, we use the _____ scale.

6. Which one of these would you use to measure the following: meter, liter, and gram?

   a. the amount of water in a pail _____
   b. the length of the door _____
   c. the weight of a penny _____

METRIC TEST FOR STUDENTS - Grade Level 3

Directions: Fill in the blanks with the correct answer. Use the word list from the board. The symbols are also on the board.

1. Meters and centimeters are used to measure _____ in the metric system.

2. "_____" means "1 part of 100 parts."

3. 500 cm = _____ m 4. _____ cm = 7 m

5. In the space below, try to draw a line about 1 cm long without using your ruler.

6. The _____ is a unit used to measure capacity in the metric system.

7. "Kilo-" means _____.

8. One kilogram is the same weight as _____ grams.

9. 2000 g = _____.

10. _____ g = 5 kg.

METRIC TEST FOR STUDENTS - Grade Level 4

Directions: Fill in the blanks with the correct answer. Use words from the board.

1. The base unit of length in the metric system is the _____.
2. A unit in the metric system often used to measure how much liquid something holds is the _____.
3. "Centi-" means "_____."
4. Write the names of three units of measure in the metric system that begin with "centi-":

   _____ _____ _____

5. "Kilo-" means "_____."
6. Write the names of three units of measure in the metric system that you have studied that begin with "kilo-":

   _____ _____ _____

7. The base unit of mass (weight) in the metric system is the _____.
8. The unit used to measure temperature is the _____.
9. Write the symbol for each of the following:

   a. meter _____ b. centimeter _____ c. liter _____

   d. gram _____ e. kilometer _____ f. kilogram _____

10. Answer true or false:

    The metric system is a decimal system of measurement _____.

METRIC TEST FOR STUDENTS - Grade Level 5

Directions: Fill in the blanks with the correct answer.
You may use your notes.

1. In the metric system, the _____ is the unit of length.
2. a) 1 _____ = 1000 m b) 1 cm = 10 _____.
3. The liter is a unit of _____ in the metric system.
4. a) 1 kl = 1000 _____ b) 1 L = 1000 _____.
5. The base unit of weight in the metric system is the _____.
6. a) 1 kg = _____ g b) 1 g = _____mg
7. The units of length, capacity, and mass have a relationship in the metric system. For example: a box 10 cm wide, 10 cm long, and 10 cm high has a capacity of 1_____; one liter of water has a mass of 1 _____. A box 1 cm wide, 1 cm long, and 1 cm high has a capacity of 1 _____; 1 milliliter of water has a mass of 1 _____.
8. In the metric system, the unit used in everyday life to measure temperature is the _____ Celsius.
9. Normal body temperature is _____ ^{o}C.
10. The base unit of time in the metric system is the _____.

METRIC TEST FOR STUDENTS - Grade Level 6

Directions: Fill in the blanks with the correct answer/ answers. Use correct spelling.

1. List in the correct columns below the metric units you have studied this year.

Length	Capacity	Mass	Area
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	

2. You have studied some prefixes that are used in the metric system. List them.

_____ _____ _____ _____

3. Why is the meter called the primary unit of the metric system?

_____

_____

_____

4. Why is the metric system called a decimal system? _____

_____

5. When the metric system is used, the _____ thermometer is usually used too. Using this thermometer, what is your normal body temperature? _____

6. In the metric system, speed is usually measured in _____. Road speed limits are given in _____.

Appendix H

METRIC INSERVICE WORKSHOP ACTIVITIES

Session	Program	Leader
One Tuesday 9/20/77 2:30 p.m. to 4:00 p.m.	Orientation for teachers Brief metric history Advantages and disadvantages of metrics Metric measurement in industry home, school, and highways Varied hands-on measurement activities	Thelma Butler (Program Coordinator)
Two Thursday 9/22/77 2:30 p.m. to 4:00 p.m.	Eye Gate filmstrip, Joseph La Grange, AIMS 16 mm film, A Metric America Discussion of film Question and answer period	Thelma Butler
Three Tuesday 9/27/77 2:30 p.m. to 4:00 p.m.	Uses of metric systems and prefixes Handout: "All you need to know about metrics" Worksheets and activities	Shirley Hagan (Mathematics Supervisor)
Four Thursday 9/29/77 2:30 p.m. to 4:00 p.m.	Videotape on mass and volume Handouts on activities and teaching strategies	Barbara Johnson (Area Resource Teacher)

Session	Program	Leader
Five Tuesday 10/4/77 2:30 p.m. to 4:00 p.m.	Videotape on meters and liters Hand on activities Metric teaching strategies and activities	Barbara Johnson
Six Thursday 10/6/77 2:30 p.m. to 4:00 p.m.	Summary and remarks concerning workshop lectures and activities Additional handouts on teaching strategies School Principal, Mr. Lapriola, expressed appreciation to entire teaching staff and program coordinator	Thelma Butler

Appendix I

DATES OF CLASSROOM OBSERVATIONS AND FOLLOW-UP CONFERENCES*

N=18

Teacher	Observation 1	Observation 2	Observation 3
	1977	1978	1978
T1	October 4	January 10	March 8
T2	October 4	January 10	March 8
T3	October 4	January 10	March 8
T4	October 17	January 10	March 13
T5	October 17	January 12	March 13
T6	October 25	January 12	March 6
T7	October 25	January 12	March 6
T8	October 26	February 9	March 7
T9	October 26	January 17	March 7
T10	October 13	February 8	March 6
T11	October 13	January 17	March 15
T12	October 13	January 24	March 15
T13	October 6	January 24	March 20
T14	October 6	January 24	March 20
T15	October 6	February 8	March 7
T16	October 11	February 8	March 21
T17	October 11	February 7	March 21
T18	October 11	February 7	March 6

*In each instance, the follow-up conference was held the same day as the classroom observation.

Appendix J

POST-PROGRAM ASSESSMENT QUESTIONNAIRE FOR TEACHERS

Please answer the following questions:

1. Have you had a college course in metrics?

   Yes _____ No _____

2. Do you feel qualified to teach the metric system?

   Yes _____ No _____

3. Do you know the state mandate for teaching the metric system?

   Yes _____ No _____

4. How prepared are you in the basic fundamentals of metrics?

   a. very well ___ b. fairly well ___ c. inadequately ___

5. How prepared are the students in your class in metrics?

   a. very well ___ b. fairly well ___ c. inadequately ___

6. Are you teaching metrics in your class?

   a. very much ___ b. very little ___ c. not any ___

7. Do you feel there is a need for metric workshop/inservice?

   Yes _____ No _____

Appendix K

TEACHERS' EVALUATIONS OF THE METRIC WORKSHOPS

Questionnaire

N=18

1. I participated in:

6 workshops	18*
5 workshops	0
4 workshops	0
3 workshops	0
2 workshops	0
1 workshop	0
0 workshops	0

2. I would rate the 6 workshops as:

Excellent	9
Very good	3
Average	6
Poor	0

3. The workshops did the following thing(s) for me: (Check one or more.)

18	Helped me to understand the metric system better
16	Provided me with helpful information
10	Gave me an opportunity to ask specific questions
0	Did not provide anything new
0	Failed to give me the information I needed most

4. The part I liked best about the workshops was: (Check one or more.)

18	The video tapes
18	Firsthand information
18	The orderly function of the program
18	Everything, including sharing ideas with others
0	Nothing

*Numbers in the blanks represent number of responses to the item.

5. If another similar workshop is planned, I would suggest that the following things be considered:

18	Offer a greater variety of materials
6	Allow more persons to take part in the planning
17	Hold more workshops earlier in the year
7	Give more explicit information on metric background and SI
18	Do similar kinds of workshops each year

Appendix L

COORDINATOR'S EVALUATION OF TEACHERS' CLASSROOM PERFORMANCE

N=18

Skills Observed	Percent of Teachers Attaining Rating		
	Observation		
	1	2	3
1. Lesson preparation			
Excellent	0	6	16
Very good	22	50	78
Acceptable	44	33	6
Needs Improvement	33	11	0
2. Aims and procedures clearly defined			
Excellent	0	22	33
Very good	11	50	67
Acceptable	67	17	0
Needs improvement	22	11	0
3. Appropriate variety of activities			
Excellent	0	22	33
Very good	22	44	56
Acceptable	33	22	11
Needs improvement	44	11	0
4. Use of motivational factors			
Excellent	0	17	44
Very good	11	28	36
Acceptable	67	50	0
Needs improvement	22	6	0

5. Knowledge of subject matter			
Excellent	0	11	22
Very good	11	11	67
Acceptable	11	56	11
Needs improvement	78	22	0
6. Sufficient teaching aids			
Excellent	0	22	33
Very good	22	33	56
Acceptable	56	33	11
Needs improvement	22	11	0
7. Systematic and orderly progression			
Excellent	0	22	39
Very good	22	39	50
Acceptable	44	22	11
Needs improvement	33	17	0
8. Full class participation			
Excellent	0	33	56
Very good	11	22	44
Acceptable	56	22	0
Needs improvement	33	22	0
9. Method of homework (or class) assignment			
Excellent	0	28	78
Very good	17	33	22
Acceptable	61	33	0
Needs improvement	22	6	0
10. Evidence of metric displays			
Excellent	0	22	44
Very good	22	33	56
Acceptable	22	44	0
Needs improvement	56	0	0

Appendix M

TEACHERS' PRE- AND POST-TEST METRIC SCORES

N=18

Teacher	Scores in Percents		
	Pretest	Post-test	Difference
T1	58	94	+36
T2	61	100	+39
T3	68	100	+32
T4	52	90	+38
T5	48	87	+39
T6	48	87	+39
T7	77	100	+23
T8	68	90	+22
T9	58	94	+36
T10	68	100	+32
T11	55	100	+45
T12	52	100	+48
T13	52	100	+48
T14	55	100	+45
T15	61	100	+39
T16	71	100	+29
T17	61	100	+39
T18	61	100	+39

Appendix N

STUDENTS' METRIC POST-TEST SCORES BY GRADE LEVEL

N=444

Grade Level	Number of Children	Scores in Percents 91-100	81-90	71-80	61-70	Below
1	71	54	42	3	1	0
2	93	58	40	1	0	1
3	82	49	48	2	1	0
4	77	57	40	1	1	0
5	56	86	13	1	0	0
6	65	86	12	1	0	0
Totals*	444	63	34	2	0	0

*The total scores represented on this line were derived from numbers of children achieving the various levels, expressed here in percentages.